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Dialogical Fingerprinting of Debaters

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In debates and dialogues, individual speakers exhibit characteristic communicative tendencies, such as using shorter or longer sentences, an idiosyncratic vocabulary, and speaking at particular times during the dialogue. Such and other characteristics underpin the emerging fields of Debating Technology and Debate Analytics [1]. As part of this goal of supporting and enhancing human debate and argument, we present *Dialogical Fingerprinting*, a system that uses these behavioural characteristics to build a unique dialogical fingerprint for the speakers within a debate. The dialogical fingerprints allow the individual identification of speakers and their roles, extending existing Debate Analytics.

The data used for the Dialogical Fingerprinting demonstrator comprises 21 transcribed episodes of The Moral Maze, a BBC Radio 4 programme about ethically divisive or controversial issues. The participants in each 43-minute episode are: the moderator, present in every episode; four panellists, drawn from a small pool of regulars; and three guest witnesses, who are experts on the topic debated in that episode. This leads to a total of 93 individual speakers within the dataset, with an unbalanced distribution. A subset of the transcripts is annotated on the basis of Inference Anchoring Theory, explicitly indicating discourse segments, communicative functions, and argumentative structure [2].

Using scitkit-learn and Keras (with TensorFlow back-end), Dialogical Fingerprinting models the behavioural characteristics of a speaker as features in a machine learning approach. Within a Moral Maze episode, each participant fulfils a distinct debating role (moderator, panellist, or witness). Each role is associated with a characteristic dialogical fingerprint common to all individual speakers in that particular role. We use this common dialogical fingerprint to automatically classify the participants' debating roles. Similarly, by using behavioural characteristics to build a unique dialogical fingerprint for each individual speaker, we are able to automatically classify a participant's identity.

Upon testing various machine learning models, a Support Vector Machine (SVM) outperformed the other techniques. When training on 20 episodes and testing on one full episode, the initial role classification resulted in a macro F1 of 0.75. After implementing a post-processing rule reflecting the fact that any speaker only ever performed one particular role within a single Moral Maze episode, the macro F1 reached 1.0. The results for the much harder task of identifying the individual speaker on the basis of their contributions to the debate yielded a macro F1 of 0.52, again using an SVM model. While this appears to be a modest performance, we have to take into account that this result was achieved when testing on a previously unseen episode, in which three of the speakers are unique to that episode and therefore absent from the training data.

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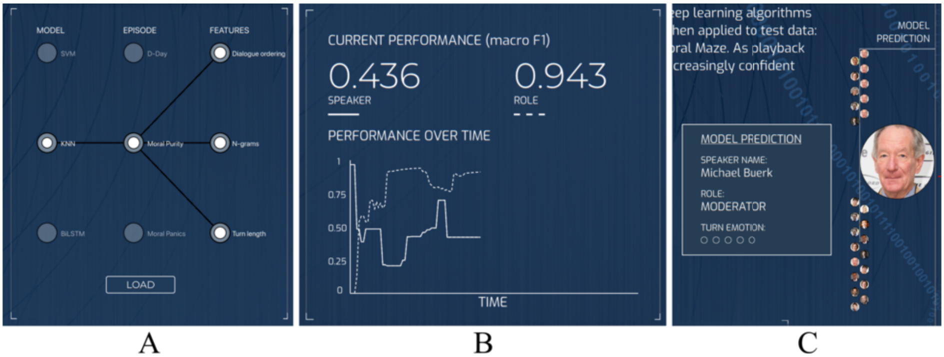

Figure 1. Elements of the interactive demonstrator: (A) selection of model, data, and features; (B) time-based graph indicating model performance, the speaker and role classification are shown as 0.436 and 0.943 respectively at the current point in the episode; and (C) model predictions for selected speaker.

In addition to classifying individual speakers and their roles, we automatically analysed the relative emotionality and ideological scaling of debaters. Using the subjectivity lexicon developed by Wilson et al. [3], we counted occurrences of lexemes that carry a positive or negative sentiment, and cast these values to a 0 to 1 interval. To group debaters in a Moral Maze episode on the basis of ideological scaling, we adopted the unsupervised methods developed by Glavas et al. [4], comparing the language used by the speakers to data for which the ideological orientation is known, such as political manifestos.

To demonstrate the software, we developed a touch-based graphical user interface (GUI), giving non-experts an intuitive way to interact with the underlying machine learning models and Debate Analytics. The GUI prompts users to choose a machine learning algorithm, an episode to test the performance on, and the dialogical features to be included (Figure 1A). Using this selection, the software demonstrates the gradual improvement of the speaker and role classifiers as the episode progresses (Figure 1B), the emotionality of the speakers' turns (Figure 1C), and their ideological scaling.

Dialogical fingerprinting demonstrates that it is possible to identify participants of a debate based not only on *what* they say, but *how* they say it, opening up new areas of research in person identification within dialogue and debates.

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